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Critical success factors in the design of suitable oncology platforms

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Abstract Cancer, a chronic disease has become one of the primary causes of death in advanced countries. The diagnosis, medication and treatment for cancer is very expensive. Healthcare providers, especially in cancer care, need to automate and accelerate access to patient data and evidence based decision making along with greater quality control and safety. Oncology information systems (OIS) provide a simple solution for this. This study compared 3 different leading international oncology information systems capable of delivering high-value, patient centred care to cancer patients in the Australian context. This work analysed functionality, usability and interoperability of these systems for the Australian healthcare environment and their integration with existing systems and assets. Critical success factors in the design of platforms to make them perform better from clinicians' and patients' points of view have also been discussed.

Keywords: • Healthcare • Oncology • Information Systems • Critical Success Factors • Clinicians •

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1 Introduction

Along with other chronic diseases, cancer has become one of the leading causes of death ("Cancer in Australia," 2017; Torre, Siegel, Ward, & Jemal, 2016; Yach, Hawkes, Gould, & Hofman, 2004). By the age of 85, one in two Australians will be diagnosed with cancer and 1 in 5 will die from cancer ("Twitter graphic cancer in Aust 2017,"). Males (around 54%) are more likely to suffer from cancer than females (around 46%). 1 in 3 males whereas 1 in 4 females will be identified with cancer by the age of 75 ("Cancer in Australia 2017," 2017). As shown in Table 1, it was estimated that in 2017 around 134,174 people will be identified as cancer sufferers and that the number of cancer cases is expected to rise further to 150,000 till 2020. Cancer related treatments and medicines are extremely expensive; in Australia, the health care system bears most of the burden which is more than $4.5 billion (6.9%) ("Cancer in Australia," 2017). Typical, treatment protocols of cancer patients involve surgery, radiation therapies and chemotherapy (Crawford, 2013). These procedures involve critical control over surgery, the amount of radiation and cytotoxic doses for chemotherapy (Wickramasinghe, Haddad, Vaughan, Han-Lin, & Moghimi, 2015).

Table 1: Estimated incidence of all cancers combined, by sex, 2017 ("Cancer in Australia 2017," 2017)

	Males	**Females**	**Persons**
Number of cases	72,169	62,005	134,174
Age-standardised rate	525.9	422.9	469.6
Per cent of all cancer cases	53.8	46.2	100.0
Risk to age 75	1 in 3	1 in 4	1 in 3
Risk to age 85	1 in 2	1 in 2	1 in 2

In general, people living in Australia have a better chance of survival than people living in other parts of the world ("Cancer in Australia 2017," 2017; "Cancer in Australia in breif 2017," 2018; "Twitter graphic cancer in Aust 2017,"). This is attributed to better awareness and improved clinical care (Crawford, 2013). The overall reduction in cancer incidences, in Australia is primarily due to decreased number of cases in prostate cancer in men ("Prostate cancer in Australia," 2013). This decline in cancer trends could be associated to increased awareness and prostate specific antigen (PSA) testing in males ("Cancer in Australia in breif 2017," 2018).

2 Need for OIS (oncology information system)

Owing to new advancements in diagnostic and treatment therapies, today we are in a better position to identify early and understand more fully diseases and their management, resulting in longer and healthier life outcomes ("Cancer in Australia 2017," 2017). This

era of knowledge and easy access to information through the Internet, print and electronic media has made us more demanding of every aspect of health and wellbeing (Duckett & Willcox, 2015). It is a well-established fact that improved health literacy leads to better health outcomes (Nutbeam, 2008). Overall, it has put an enormous burden over global healthcare systems due to an ageing population (Prince et al., 2015; Yach et al., 2004). In such a challenging situation, even a small error in treatment, documentation or missing a scheduled appointment can be fatal and can cost a huge amount to the healthcare system (Berwick, 2003). To cope with these errors and get up to date information about patient history, medication and treatments, electronic health records and data systems have been introduced in many advanced countries (Sulaiman & Wickramasinghe, 2014; Wickramasinghe & Schaffer, 2010). These electronic healthcare records (EHR) can help in managing a single record instead of multiple records for same patient, and thus also reducing multiple testing/treatment or medication (Duncan et al., 2010; Hillestad et al., 2005).

Especially, when it comes to treating of cancer patients, the need to avoid every possible error becomes even more crucial due to the toxicity and cost of drugs and radiation therapies (Evans, Ashbury, Hogue, Smith, & Pun, 2014; Fasola et al., 2008). Therefore, the need to synchronize all treatments, provide instant access to updated records and information on the latest state of tumour/disease and informed decision making through a cancer registry becomes very crucial (Duncan et al., 2010). No two cancer patients are the same, even though there might be two persons having similar conditions and symptoms of cancer, their treatment plan and recovery will vary depending upon a variety of different factors (Štambuk, Šundov, Kuret, Beljan, & Anđelinović, 2010; "Understanding Cancer," 2018). Therefore, their treatment needs to be very personal and entirely customised to help them recover better and faster ("No two breast cancer patients are the same and treatment should be tailored ", 2018). Thus, arising a necessity for incorporating a variety of treatment plans and multidisciplinary departments within or across the hospitals into one single system (Crawford, 2013; Herre & Heller, 2004).

The utilization of an oncology information system (OIS) helps in integration of radiation oncology, particle therapy and medical oncology patient data into a single database with multi-user and multiple site access (Janssen et al., 2017). The OIS seamlessly connects to any linear accelerator and treatment planning system. It also helps in the evaluation and comparison of patients under treatment to existing data in cancer registries, using artificial intelligence (A.I.) to speed up process and minimize errors. Development of disease specific clinical protocols are made easy by OIS and it helps in generating standard and consistent care (Krayenbuehl, Norton, Studer, & Guckenberger, 2015). By utilizing OIS, clinicians can monitor the amount of dose and review treatment images in one single system to determine if they need to change the dosing plan (Cheng, Wu, Liu, & Kwong, 2011).

3 Methodology

The objective of this exploratory qualitative study was to assess the critical aspects of leading OIS when implemented into the Australian healthcare context. To do this, we adopted a mixed methodology; first we compared 3 leading solutions that were developed either in US or Europe. Comparisons were made by performing a hermeneutic analysis on all publically available data. In addition, site visits (public and private healthcare sector) took place. We then conducted focus group discussion respectively with patients and clinicians (in both the public and private sectors) to further ascertain their perspectives of features they would like in such systems and how these might be beneficial. The initial findings are presented below.

3.1 Comparison and discussion of different OIS:

Three different leading international oncology information systems were analysed. Specifically, their main features as relevant and beneficial in the Australian health care system for cancer care were examined. The summary of the comparison is presented in Table 2. After completing the comparison for these systems, a focus group discussion with oncology clinicians & patients was conducted to further gain important insights.

From Clinician and healthcare provider's point of view it was noted that most of the providers (public hospitals and private) have had different systems of patient data recording and maintaining. This makes it challenging for clinicians who must work with multiple systems. Different hospitals are now collaborating, or amalgamating to become a big single healthcare provider through acquisitions. This then means that they need to integrate their previously separate systems within and across the different sites. This is challenging however, due to the differences of existing infrastructure and their versions; hence, more often than not poor integration, disrupted work flow and different user interfaces result. After discussions with oncology clinicians and managers at different healthcare organisations, critical factors were identified to improve the overall performance of OIS including:

- Adherence to agreed international and Australian standards
- Interoperability and leverage of existing assets and capabilities
- Need to fit Australian/Victorian healthcare system e.g., VMOs (visiting medical officers)
- Inclusion of billing and concession through PBS and MBS systems
- Need for real time data exploring, updating and communication of change in plan
- Special attention to encryption, privacy and cyber security issues
- Need for auto triggering and notification of change in plan for medication or radiation
- Need to distribute and calculate share for specialists and nurses
- Licensing issues within and among different health care providers
- Transferring and accessing data within and from different sites

- Access for organizations not having OIS e.g., Medicare or other agencies
- Consistency around treatments protocols, timelines and costing forecasting
- Web based with login access from anywhere
- Value for money, the selected digital technology must be cost effective and productive
- OIS must be capable for keeping track of safety and quality control in medication, treatment, scheduling of appointments.

From patient, family members and care provider's points of view, it was found that the person who suffers the most is the cancer patient and family members. The patient and family members' needs and desires tend to be the most ignored during the treatment and recovery phases and hence the patient experience is less than satisfactory. For many clinicians, nurses and healthcare providers the patient is just another subject and one more case study for different treatments. The patients were desirous of more empowerment and access to information and data through psychological surveys, awareness / training, visual treatment, booking/cancelling/ rescheduling their appointments. Further, having the capacity to participate in patient reported outcomes and self-reporting pain and progress of recovery on a daily and hourly basis was key for them to improve their patient experience. Many patients also wanted the ability to log their medication e.g., missing and on-time or ordering for repeats. To summarise, the key factors from Australian patient point of view:

- Pain grading and registering
- User friendly interface and ease of interpretation
- Psychological, emotional and social support or stories
- Up to date knowledge on new treatments and ongoing research
- Training and visual experiences for treatments and therapies
- Automatic concession and payments through PBS and MBS
- Keeping privacy and confidentiality of patients, the data should be available anonymously for research and matching with similar case studies, their implications, complications and recoveries.

Table 3: Comparison of different leading international oncology inforamtion systems (OIS) in Australian context

	System A	System B	System C
Multiple therapies (medical & radiation oncology)	• Yes	• Yes	• Yes
Billing	• Billing & cancer registry • Missed-procedure billing advisories • Export billed items to HL7-compliant billing software	• Billing and other third-party systems	• Claims and billing data from financial systems
Image management	• Comprehensive review of clinical images • Optimized image-guided treatment techniques • Review images remotely and send set-up instructions to the treatment machine • Review dosimetric images for IMRT pre-treatment quality assurance • Compare images using automatic, manual or fiducial marker-matching algorithms • Attach images, files or patient photographs to documents	• Sophisticated image visualization & distribution • 3D viewers: RTP, XVI, & iView GT™ integration, adding and synchronizing tools, 2D image registration, volume image viewing • External image registration • Stereoscopic & volume image registration • Setup details, immobilization devices and reference images entered into treatment chart	• Present complex, personalized analytics on individual patients based on clinical, molecular, and other relevant data in a clinically actionable format
Clinician led and patient-centric	Appointment scheduling, review images remotely, customisable data collection forms and questionnaires	Electronic patient management allows users to achieve a paperless, filmless working environment; treatment setup	Configure CARE reports to contain personalized analytic content and historical patient content formatted to your

		workflow management	institution's & clinician's specific needs
Information and analytics	Pain scoring to identify trends	Trend analysis	Integration, aggregation & personalized analytics on highly complex, disparate, multi-institutional data sources
Adherence to agreed standards and interoperability & leveraging existing assets and capabilities	Automates patient-data transfer with external hospital systems using standard communication protocols	Seamless connectivity to virtually any linear accelerator & treatment planning system from any vendor, providing unmatched integration, freedom and flexibility	IT team, data and network security resulting in very fast time-to-value.
PBS / MBS	-	-	-
Robust privacy, security and data protection	Built-in EDI (electronic data interchange) for secure online claim submissions High Availability and Rapid Recovery Protection (HARRP) continuous data protection and ensures minimal data loss and immediate recovery	Eliminate error-prone work through tight integration that enables the seamless transition of data between tools	-
Safety and Quality	Facilitates compliance with the Work Health and Safety (WHS) Act	Manual, barcode and biometric patient identification and verification options provide multilevel safety checkpoints	Quality and safety reporting.
Comparison of cost, complications, toxicity and practice	-	-	System C gives comparison of cost, complications, toxicity and even between different practice centres or clinics.

4 Conclusion

This study is a first step in a longer research stream to identify key needs and critical success factors for OISs. We conducted a comparison of 3 leading international OISs and followed this up by focus group discussions with clinicians and patients (both public and private healthcare sectors) respectively. Our initial findings have been summarized above. Cancer is becoming a leading cause of death globally and has stretched healthcare budgets due to expensive medicine and radiation therapies. Oncology information systems can help in integrating patient history, imaging data, medication, radiation, recovery & progress and change in plan from multiple users and multiple sites. Unfortunately, most of the leading international OIS available are not designed and customized for the Australian context. Communication and interoperability among existing systems and assets along with access to medical specialists and government agencies for up to date data monitoring and subsidized treatments need to be included into these systems. From patient's prospective, ease and access of using systems for appointment scheduling, rescheduling and cancelling, learning regarding treatment protocols and pathways available, survivor stories, peer and family support, pain grading & registering and finally medication missing or overdosing logging were main concerns. Inclusion of these key factors into any oncology information systems will make such system more likely to gain strong clinician and patient user satisfaction and thereby provide a successful and superior transformation of care in this context.

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